# AUSTRALASIAN CERATOPOGONIDAE (DIPTERA, NEMATOCERA).

## Part X: Additional Australian Species of Culicoides.

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(Plate xiii; 55 Text-figures.)

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*Synopsis.*

The present paper describes twelve new species of *Culicoides* from eastern Australia and introduces new synonymy for two other species from the same region. Two species previously known only from the New Guinea area are also recorded from north Queensland.

## Introduction.

In the course of our continuing studies of Australian biting midges we have found that as more and more collecting is done occasional specimens of relatively rare species are taken, until eventually a series sufficient for reasonable description is acquired. In other cases species we have known to exist from one specimen only may eventually be taken in numbers when a new locality or habitat is explored. Although most of the new species herein described are relatively rare in our collections, this is more than likely to be due to a failure to use the most suitable methods of collection in the most favourable habitats.

Illustrations are given of the interorbital spaces, palpi, segments 9–12 of the antennae, and spermathecae of all species and of the male genitalia when this sex is available. Wings are reproduced photographically for all species. All measurements are given in Table 1.

Apart from the primary division into species with apex of second radial dark or pale, the species are described in the order of increasing complexity of wing pattern.

(*a*) *Descriptions of New Species.*

(i) *Species with second radial cell dark.*

### Culicoides smeei Tokunaga.

Tokunaga, M., 1961. *Akitu*, 9: 73. Tokunaga, M., 1962. *Pacific Insects*, 4: 462.

This species was originally described from Keravat, New Britain. In general appearance it is similar to *C. immaculatus* L. & R., but differs particularly in the restriction of the macrotrichia to the distal quarter of the wing, the contiguous eyes, and the more elongated distal antennal segments.

*Distribution*: Queensland, Mackay, Pioneer R., 10:v:1955, E. J. Reye; Townsville, Belgian Gardens, 17:xi:1955, A. K. O'Gower.

### Culicoides purus, n. sp.

*Types*: Holotype ♀, allotype ♂ and 1 ♂ and 1 ♀ paratype. All in S.P.H.T.M.

*Type Locality*: Hornsby, New South Wales. All from light trap, D. J. Lee. Holotype 24:x:1956, the rest 31:x:1956.

*Distinctive Characters*: A species without markings on the wing which could only be confused with *C. immaculatus* in which the sensory pit of the third segment of the palp is less than a quarter the length of the segment instead of almost half. *C. purus* is a slightly larger species with a close affinity to *C. immaculatus*.

*Description*: From the type series, all mounted specimens. Measurements from holotype ♀ and 1 ♀ paratype and allotype ♂.

TABLE 1.

*Measurements of Various Species of Culicoides.*

| | | *purus.*[1] | *marginalis.* | *leanderensis.*[1] | *mackerrasi.* | *narrabeenensis.* | *interrogatus.*[2] | *sigmoidus.*[4] | *mykytowyczi.* | *henryi.* | *hornsbyensis.*[1] | *fulbrighti.* | *pallidothorax.*[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ♀♀ | | | | | | | | | | | | | |
| Wing length | Holotype | 1·18 mm. | 0·89 mm. | 0·91 mm. | 1·06 mm. | 1·14 mm. | 1·18 mm. | 1·37 mm. | 1·39 mm. | 1·22 mm. | 1·22 mm. | 1·71 mm. | 0·97 mm. |
| | Average of selected series | 1·20 mm. | 0·97 mm. | 0·89 mm. | 1·08 mm. | 1·12 mm. | 1·20 mm. | — | 1·35 mm. | 1·16 mm. | 1·14 mm. | 1·52 mm. | 0·99 mm. |
| | Range in above | 1·18–1·23 mm. | 0·89–1·04 mm. | 0·87–0·91 mm. | 1·06–1·14 mm. | 1·04–1·20 mm. | 1·10–1·33 mm. | — | 1·3 – 1·4 mm. | 1·14–1·22 mm. | 1·14–1·22 mm. | 1·33–1·71 mm. | 0·91–1·03 mm. |
| Antenna | Holotype, 3–10 | 336μ | 192μ | 276μ | 360μ | 240μ | 276μ | 240μ | 336μ | 288μ | 288μ | 336μ | 252μ |
| | ,, 11–15 | 360μ | 192μ | 240μ | 324μ | 360μ | 324μ | 300μ | 336μ | 324μ | 360μ | 384μ | 276μ |
| | Average of selected series | | | | | | | | | | | | |
| | 3–10 | 324μ | 192μ | 240μ | 348μ | 216μ | 293μ | — | 300μ | 264μ | 264μ | 312μ | 258μ |
| | 11–15 | 360μ | 228μ | 204μ | 312μ | 354μ | 342μ | — | 300μ | 324μ | 312μ | 384μ | 276μ |
| Palp | Holotype, segment 2 | 60μ | 36μ | 48μ | 84μ | 42μ | 72μ | 60μ | 120μ | 96μ | 60μ | 60μ | 66μ |
| | ,, ,, 3 | 84μ | 48μ | 60μ | 90μ | 60μ | 72μ | 72μ | 108μ | 84μ | 96μ | 72μ | 66μ |
| | ,, ,, 4 | 30μ | 24μ | 30μ | 36μ | 24μ | 30μ | 24μ | 36μ | 30μ | 24μ | 24μ | 24μ |
| | ,, ,, 5 | 24μ | 18μ | 30μ | 36μ | 24μ | 30μ | 18μ | 36μ | 24μ | 18μ | 24μ | 18μ |
| Hind leg | Holotype, femur | 444μ | 276μ | 360μ | 444μ | 348μ | 408μ | 384μ | 504μ | 420μ | 396μ | 444μ | 348μ |
| | ,, tibia | 468μ | 276μ | 372μ | 444μ | 360μ | 324μ | 432μ | 480μ | 396μ | 396μ | 480μ | 336μ |
| | ,, tarsus I | 204μ | 132μ | 180μ | 228μ | 168μ | 192μ | 192μ | 216μ | 180μ | 180μ | 240μ | 144μ |
| | ,, ,, II | 120μ | 60μ | 96μ | 114μ | 72μ | 96μ | 108μ | 108μ | 84μ | 96μ | 120μ | 60μ |
| | ,, ,, III | 72μ | 36μ | 60μ | 66μ | 42μ | 60μ | 66μ | 72μ | 60μ | 60μ | 78μ | 42μ |
| | ,, ,, IV | 48μ | 54μ | 48μ | 54μ | 30μ | 36μ | 42μ | 60μ | 36μ | 48μ | 54μ | 36μ |
| | ,, ,, V | 60μ | 36μ | 48μ | 60μ | 36μ | 48μ | 54μ | 60μ | 48μ | 48μ | 60μ | 48μ |
| | Average of selected series | | | | | | | | | | | | |
| | Tarsus I | 204μ | 144μ | 168μ | 240μ | 156μ | 174μ | — | 204μ | 180μ | 180μ | 228μ | 168μ |
| | ,, II | 120μ | 60μ | 84μ | 108μ | 67μ | 90μ | — | 96μ | 89μ | 86μ | 120μ | 72μ |
| Spermathecae | Holotype a | 72×60μ | 36×36μ | 60×36μ | 84×48μ | 60×36μ | 42×42μ | 60×42μ | 48×48μ | 72×60μ | 48×48μ | 60×48μ | 72×60μ |
| | ,, b | 60×48μ | 36×36μ | 48×36μ | 48×48μ | 42×36μ | 42×42μ | 54×42μ | 48×38μ | 72×60μ | 48×48μ | 60×48μ | 72×60μ |
| | ,, c | — | 7μ | 8μ | — | 12μ | — | — | 8μ | — | 8μ | duct 24μ | 18μ |
| | ,, d | — | 7μ | 8μ | — | — | — | — | — | — | — | duct 12μ | — |
| ♂♂ | | | | | | | | | | | | | |
| Wing length | Allotype | 1·08 mm. | — | — | — | 0·95 mm. | — | 1·27 mm. | — | 1·16 mm. | 1·1 mm. | 1·46 mm. | — |
| Antennae | Allotype 3–12 | 324μ | — | — | — | 324μ | — | 312μ | — | 420μ | 396μ | 420μ | — |
| | ,, 13–15 | 300μ | — | — | — | 252μ | — | 252μ | — | 288μ | 312μ | 384μ | — |

[1] Instead of average measurements, those of the ♀ paratype are given.

[2] Averages from holotype and 2 paratype ♀♀.

[3] Averages from holotype and 3 paratype ♀♀.

[4] Measurements from holotype and allotype only.

*Female.*

A uniformly brown species (mesonotal pattern not discernible but certainly not pronounced); legs without distinct markings. Wing membrane with a brownish tinge from C through R to median stem.

*Head*: Basal flagellar segments longer than wide, 5–10 vasiform, 11 a little less than twice the length of 10. 10–14 equal, vasiform, 15 slightly longer tapering at tip. Antennal ratio 0·9. Palps with segment 3 swollen at middle, pit large, fairly deep, extending from middle almost to apex (almost half as long as segment). Eyes well separated, mouth parts distinctly shorter than height of head.

*Thorax*: Legs unmodified. Tibial comb 4. Tarsal ratio 1·7. Wings without spots, radial cells subequal, distinct. Macrotrichia strong but not dense.

*Abdomen*: Two subspherical spermathecae with distinct necks to the ducts.

*Distribution*: Only known from the type locality. Additional dates 19:xi:1956, 9:1:1957, 23:1:57 and 2:ii:1957 (all light trap, D. J. Lee).

*Male.*

Similar to ♀, except for sexual differences; genitalia as figured.

### Culicoides melanesiae Macfie.

Macfie, J. W. S., 1939. Proc. Linn. Soc. N.S.W., 64: 368 (not *C. melanesiae* of Tokunaga, M., 1962. *Pacific Insects*, 4: 466).

*C. melanesiae* was described by Macfie from a single female taken at Rabaul, New Britain. Because Macfie stated that the third segment of the palp was without a sensory pit and because the type, mounted under a very small coverglass, has proved very difficult to examine, previous attempts to recognize this species have not been successful.

However, a recent reexamination of the type specimen, under more critical illumination, has revealed its identity with specimens collected on the Queensland coast and with the help of these it is now possible to correct Macfie's misleading statement and characterize the species.

*Distinctive Characters*: Wing with reduced wing pattern, a pale spot over r-m and another one abutting the end of the second radial cell but not including part of the cell. Macrotrichia are strongly developed and occur over the entire wing surface. The third segment of the palp is elongated, slightly swollen at the middle and with many small, single sensory pores on the under surface for the distal three-quarters.

*Distribution*: Queensland: Green Island, north Queensland, 1:vi:1955, 1615–1630 hrs., attacking man, M. B. Wilson.

### Culicoides marginalis, n. sp.

*Types*: Holotype ♀ and 7 paratype ♀♀. In S.P.H.T.M., except 1 paratype in each of C.S.I.R.O., U.S.N.M. and B.M.

*Type Locality*: Hornsby, New South Wales. Holotype and 2 paratypes taken in light trap, D. J. Lee, 2:ii:1957. The rest, same data except 1 paratype on 7:ii:1957, 2 on 8:ii:1957 and 1 on 24:i:1957.

*Distinctive Characters*: A species with small pale wing spots most of which are marginally arranged leaving a large spot-free area. It is closest to *C. parviscriptus* Tokunaga, from which it differs in having the pale spot at the end of the radius terminating on the lower branch of the intercalary fork instead of on $M_1$, and in the absence of a pale spot in the middle of the median cell. Wing pattern also not unlike *C. leanderensis*, n. sp., but in this species the pale spot abutting cell $R_2$ is expanded below this cell and the r-m pale spot does not extend to costa. The interorbital space, palp and spermathecae are also distinct.

*Description*: From the type series; all mounted specimens. Measurements from holotype ♀ and 8 paratype ♀♀.

*Female.*

Thoracic markings not available from mounted material. Legs with pale subapical rings on anterior four legs and basal pale rings on all tibiae. Knees very dark.

*Head*: Eyes separated above, contiguous below. Mouthparts about three-quarters height of head. Basal segments of antennal flagellum about as long as wide, becoming more elongated and narrowing distally. Segment 11 about 1·5 times length of 10. Antennal ratio 0·84. Segments 11–15 subequal, with 11–14 slightly vasiform. Third segment of palp progressively enlarged from base to a maximum in distal half with single, well-developed shallow sensory pit on the distal third.

*Thorax*: Legs unmodified. Tibial comb 4. Tarsal ratio 2·4. Wings with two distinct radial cells. Spotting of fairly strong contrast but reduced especially in the middle of the wing, there being only a small pale spot at the distal extremity of the median cell. Spot over r-m small, fading to anterior wing margin. Almost entire intercalary area without pale spots except at base and close to wing margin. Macrotrichia not very dense.

*Abdomen*: Two subequal subspherical spermathecae with short stems, two additional small rudimentary spermathecae.

*Distribution*: Additional records from the type locality are 25:x:1956, 26:x:1956 and 23:i:1957 (all light trap, D. J. Lee). Also taken from Merricumbene, New South Wales, 5:i:1955 and 5:ii:1955 (A. L. Dyce). The Merricumbene specimens were bred from treeholes situated four to twelve feet above ground level in the trunks of the river oak, *Casuarina cunninghamiana*. Other diptera found breeding in these treeholes have been discussed by English, Mackerras and Dyce (1958).

### Culicoides leanderensis, n. sp.

*Types*: Holotype ♀, 1 paratype ♀ in SPHTM.

*Type Locality*: Both from Longreach, Queensland, 22:iv:1955, from net over sheep, E. J. Reye.

*Distinctive Characters*: Closest to *C. mackerrasi*, n. sp., on wing pattern, but lacking the prominent pale spot above $Cu_1$. An obvious pale area along $M_2$ and the expansion of the radial spot below cell $R_2$ distinguish it from *C. marginalis*, n. sp.

*Description*: From the holotype ♀ and measurements from this and the single paratype ♀.

*Female.*

Head: Eyes well separated. Mouthparts more than half height of head. Antennal flagellar segments mainly vasiform, segment 11 little different from 10. Antennal ratio 1·17. Palp with third segment swollen, maximum width below half-way. Sensory pit fairly deep, in third quarter.

*Thorax*: Legs unmarked, knees not dark. Tarsi unmodified. Tarsal ratio 2·0. Tibial comb 4. Wings with macrotrichia moderately developed, majority of pale areas marginal.

*Abdomen*: Two subequal ovate spermathecae, a minute rudimentary one and an accessory duct.

*Distribution*: Only known from the type locality.

### Culicoides mackerrasi, n. sp.

*Types*: Holotype ♀ and 25 paratype ♀♀. All in SPHTM, except for paratypes in each of CSIRO, QIMR, USNM and BM.

*Type Locality*: Yellow Water Lagoon, Roper River, Northern Territory. All taken biting man, A. K. O'Gower, type and 20 paratypes on 29:iv:1957, 2 paratypes with same data except 28:iv:1957 and two others 14:iv:1957.

*Distinctive Characters*: Wing multispotted with radial spot surrounding but not including end of second radial cell; intercalary spot triangular with its broad base along lower branch of intercalary fork and a pale spot on the median fork between

the r-m spot and one close to the wing tip. Other Australian species with somewhat similar pattern either have the distal part of the second radial cell pale or some form of pale area over the central part of the median cell.

*Description*: Details of coloration not available from mounted material. Measurements from holotype ♀ and 9 paratype ♀♀.

*Female.*

*Head*: Eyes separated; mouthparts about three-quarters height of head. Basal flagellar segments vasiform, segments 11–12 elongate vasiform, 13–15 elongate, almost cylindrical. Antennal ratio 1·15. Third segment of palp swollen at middle with large shallow pit at from half to beyond three-quarters length of segment.


Text-figures 1-36. 1-12, interorbital spaces (females). 13-24, segments 9-12 of antenna (females). 25-36, female palp. *C. purus*, n. sp., 1, 13 & 25. *C. mykytowyczi*, n. sp., 2, 14 & 26. *C. marginalis*, n. sp., 3, 15 & 27. *C. leanderensis*, n. sp., 4, 16 & 28. *C. mackerrasi*, n. sp., 5, 17 & 29. *C. narrabeenensis*, n. sp., 6, 18 & 30. *C. interrogatus*, n. sp., 7, 19 & 31. *C. sigmoidus*, n. sp., 8, 20 & 32. *C. henryi*, n. sp., 9, 21 & 33. *C. hornsbyensis*, n. sp., 10, 22 & 34. *C. fulbrighti* n. sp., 11, 23 & 35. *C. pallidothorax*, n. sp., 12, 24 & 36. All × 166 approx.

*Thorax*: Legs without markings; tarsi unmodified. Tibial comb 4. Tarsal ratio 2·2. Wings with radial cells equal but short; macrotrichia pronounced and moderately dense. Base of first radial cell included in enlarged spot over r-m extending from C to below $M_2$. Second radial cell dark but apex surrounded by a bilobed spot which extends to $M_1$. Intercalary spot large, broadly triangular; the only spot in the median cell is near its distal extremity.

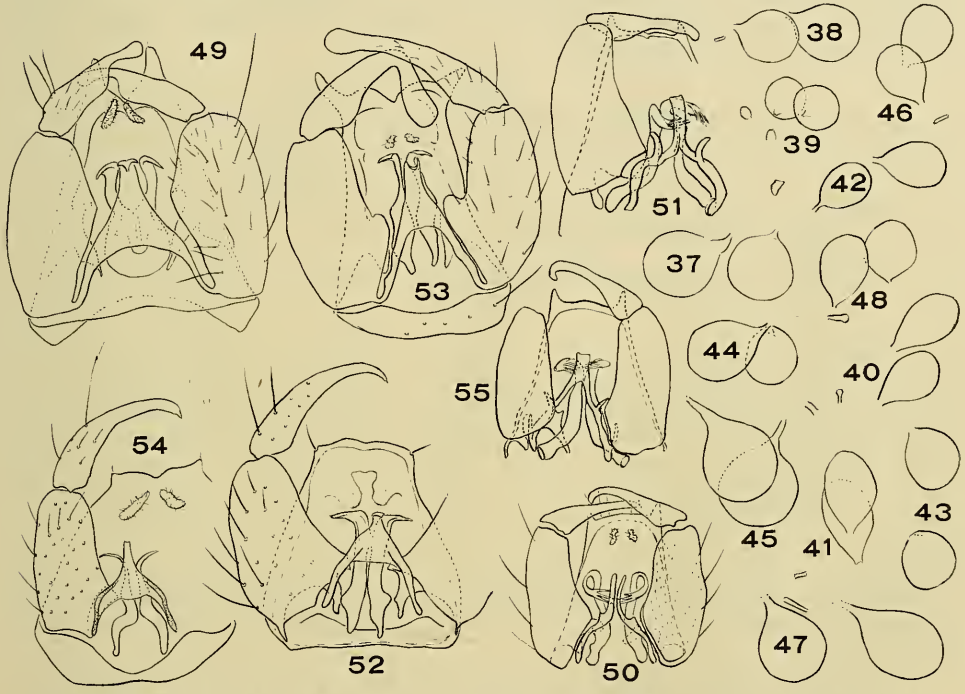
*Abdomen*: Two subequal ovoid spermathecae with short ducts.

*Distribution*: Northern Territory: the type locality and adjacent Roper R. Mission, iv:1957 and xi:1957, A. K. O'Gower. Humpty Doo, 9:xii:1956, A. K. O'Gower. All taken attracted to man or biting. Queensland: Eidsvold, 18:iv:1924, T. L. Bancroft.

### Culicoides narrabeenensis, n. sp.

*Types*: Holotype ♀, allotype ♂, 10 paratype ♀♀ and 3 paratype ♂♂. All in SPHTM, except for paratypes in each of CSIRO, USNM and BM.

*Type Locality*: Deep Creek, Narrabeen, New South Wales, W. W. Wirth, 3:iii:1957, bred from pupa (holotype). Newport, 12:12:1956, light trap, W. W. Wirth (allotype). All paratypes Narrabeen, light trap, W. W. Wirth, 26:x:1956; 9:xi:1956; 8:xii:1956; 13:xii:1956 except one from Warriewood, 23:x:1956, bred from ditch margin, W. W. Wirth. All localities within a radius of 1 mile.




Text-figures 37-55. 37-48, spermathecae. 49-55, male genitalia. *C. purus*, n. sp., 37 & 49. *C. mykytowyczi*, n. sp., 38. *C. marginalis*, n. sp., 39. *C. leanderensis*, n. sp., 40. *C. mackerrasi*, n. sp., 41. *C. narrabeenensis*, n sp., 42 & 50. *C. interrogatus*, n. sp., 43. *C. sigmoidus*, n. sp., 44 & 51. *C. henryi*, n. sp., 45 & 52. *C. hornsbyensis*, n. sp., 46 & 53. *C. fulbrighti*, n. sp., 47 & 54. *C. pallidothorax*, n. sp., 48. *C. bunrooensis* Lee & Reye, 55. All × 122 approx.

*Distinctive Characters*: Wing pattern not unlike *C. williwilli* L. & R. and *C. bunrooensis* L. & R., but distinct from both of these because the intercalary pale area does not extend above the upper branch of the fork. Similar to *C. williwilli* in details of interorbital area and palp but median processes of aedeagus short instead of extremely long.

*Description*: From the type series and unmounted material from Narrabeen. Measurements from holotype ♀, allotype ♂ and 9 paratype ♀♀.

*Female.*

Uniformly dark brown except for very distinct pattern of white spots on mesonotum, pale preapical rings on anterior four legs, present but less marked on posterior legs, and pale basal rings on all tibiae; knees very dark; halteres dark basally, white above. On the mesonotum there are irregular submedian white spots about the middle, horse-shoe-shaped white spots on either side of the prescutellar area, four small rounded spots towards the lateral margins, the first close to the humeral angle and two more

down each side of the mesonotum and an additional one between the second of these and the humeral pit. There is a less marked pale area at the posterolateral margin of the mesonotum which extends to cover the lateral quarters of the scutellum.

*Head*: Eyes separated above, contiguous below. Mouthparts about half height of head. Basal flagellar segments barrel-shaped, 9 and 10 very slightly longer, 11–15 distinctly elongated, 11 twice as long as 10. Antennal ratio 0·61. Palpi with third segment swollen at middle with large sensory pit from half-way almost to apex.

*Thorax*: Pattern as described above. Legs unmodified. Tibial comb 4. Tarsal ratio 2·3. Wings of complex pattern, radial cells distinct, about equal; macrotrichia largely restricted to distal half of wing. Basic pattern of the wing similar to that of *C. williwilli* but spots not quite so marked. The intercalary spot lies wholly within the intercalary fork and may be divided (as illustrated) or occasionally the two divisions are linked along the lower branch of the intercalary fork.

*Abdomen*: Two subequal, subspherical spermathecae with distinct ducts and an additional small rudimentary duct.

TABLE 2.
*Characters Differentiating* C. bunrooensis, C. interrogatus *and* C. sigmoidus.

| | *C. bunrooensis.* | *C. interrogatus.* | *C. sigmoidus.* |
|---|---|---|---|
| Wing: | | | |
| Pale area between cell $R_2$ and intercalary stem. | Present. | Absent. | Present. |
| Pale area between intercalary fork and $M_1$. | Present. | Present. | Absent. |
| Pale stripe on $Cu_1$ .. .. .. | Absent. | Present. | Absent. |
| Leg: | | | |
| Pre-apical pale band on hind femur .. | Distinct. | Not distinct. | Fairly distinct. |
| Pre-apical pale band on hind tibia .. | Absent. | Present. | Absent. |
| Head: | | | |
| Antennal ratio .. .. .. .. | 1·07 | 0·85 | 0·8 |
| Antennal segment 11/10 .. .. | 1·0 | 1·9 | 1·6 |
| Palp 3, length/width .. .. .. | 2·3 | 2·5 | 1·7 |

*Male.*

Resembles the ♀ in all but sex differences. Genitalia with complex harpes, ninth tergite with apico-lateral processes and aedeagus with a short median spur-like process on each side.

*Distribution*: Taken from the type locality in all months from October to March. Also South Creek, Deewhy, 28:ii:1957, W. W. Wirth; Careel Bay, 3:xi:1956, 20:ii:1958, 15:iii:1958, 27:iii:1958, all light trap, D. J. Lee. Hornsby, 5:i:1957, 23:i:1957, 31:1:1957, 2:ii:1957 and 7:ii:1957, all light trap, D. J. Lee.

### CULICOIDES INTERROGATUS, n. sp.

*Types*: Holotype ♀ and 3 paratype ♀♀. All in SPHTM.

*Type Locality*: Colo Vale, New South Wales. Holotype 3:iii:1956; A. K. O'Gower, 1 paratype on 25:i:1956, D. J. Lee, 1 on 24:ii:1958, 1 on 25:ii:1958, both A. L. Dyce.

*Distinctive Characters*: A species with many small pale wing spots of which the dumbbell-shaped spot over the intercalary area is the most striking. Distinct from *C. bunrooensis* L. & R. and *C. sigmoidus*, n. sp., as shown in Table 2.

*Description*: All specimens mounted, so no thoracic colour pattern available. Legs with preapical rings on anterior four femora, not distinct on posterior femora, basal rings on all tibiae.

*Female.*

*Head*: Eyes separated; mouthparts at least as long as height of head. Basal flagellar segments slightly vasiform, 11 about 1·75 × 10, 11–15 subequal, narrowing slightly distally. Antennal ratio 0·85. Palp with third segment elongated, broadest beyond midpoint with sensory pit from broadest point almost to tip, fairly small.

*Thorax*: Legs unmodified. Tibial comb 4. Tarsal ratio 1·93. Wings with macrotrichia well developed over most of wing surface. Radial cells about equal, distinct. Membrane brownish in area from C to median fork over R. Wing pattern of good contrast. Spot over r-m narrow and extending to C. Spot adjoining cell $R_2$ not returning below the cell. Intercalary spot narrow, somewhat dumbbell-shaped. A small spot below the post-radial one between the lower branch of the intercalary fork and $M_1$. Another small spot near base of median cell and a larger one about two-thirds length of cell. The narrow pale area along $Cu_1$ is unusual. Additional spots as illustrated, but those mentioned above are all of some diagnostic value.

*Abdomen*: Two subequal spherical spermathecae with broad but very short ducts.

*Distribution*: Apart from the type locality only known from Merricumbene, New South Wales, 14:xii:1954, A. L. Dyce; 14:i:1955, M. N. Dennis. All specimens have been taken attracted to man.

CULICOIDES SIGMOIDUS, n. sp.

*Types*: Holotype ♀, allotype ♂ in CSIRO.

*Type Locality*: Holotype, Black Mountain, Australian Capital Territory, light trap, 7:xi:1960, I. F. B. Common. Allotype from Minnamurra Falls, New South Wales, 16:xi:1960, I. F. B. Common and M. Upton.

*Distinctive Characters*: The differential characters of the three most similar species are presented in Table 2.

*Description*: From the types. Measurements from holotype ♀ and allotype ♂. All specimens mounted.

*Female.*

*Head*: Eyes narrowly separated; mouthparts about three-quarters height of head. Antennal flagellar segments 4–10 slightly longer than wide and narrowing slightly distally; segments 11–14 distinctly vasiform with swollen bases and narrowed subapically. Antennal ratio 0·8. Third segment of palp considerably swollen at two-thirds from base, prominent sensory pit in apical third.

*Thorax*: Mesonotum with pale spots at least anteriorly, but detail not available from mounted material. Legs with preapical pale rings on femora and basal pale rings on tibiae. Tarsi unmodified. Tarsal ratio 1·77. Tibial comb 4. Wing very similar to *C. interrogatus*, n. sp., but there is a pale spot below cell $R_2$, the one below the base of the intercalary fork is absent, the intercalary spot is double-curved and $Cu_1$ is not distinctly pale.

*Abdomen*: Spermathecae two, subspherical and subequal with short ducts.

*Male.*

Similar to ♀ in all but sex differences. Genitalia as figured.

*Distribution*: Apart from the type series further specimens come from Colo Vale, 18:xi:1954, light trap, and Merricumbene, 14:xii:1954, light trap, both A. L. Dyce.

CULICOIDES BUNROOENSIS Lee & Reye.

Due to an oversight the male allotype of this species was not figured in the original description (Lee and Reye, 1955). A figure of the genitalia is herein presented.

(ii) *Species with distal part of second radial cell pale.*

CULICOIDES MYKYTOWYCZI, n. sp.

*Types*: Holotype ♀ and 25 paratype ♀♀. In SPHTM, except for paratypes in each of CSIRO, QIMR, USNM and BM.

*Type Locality*: All of type series from Colo Vale, New South Wales. Holotype, 3:iii:1956, A. K. O'Gower. Paratypes, 4:iii:1956, 5:iii:1956, 6:iii:1956, 28:ii:1956 and 29:ii:1956 (A. K. O'Gower, A. L. Dyce, E. O'Sullivan). All attracted to man.

*Distinctive Characters*: Not to be confused with any other Australian species with distal part of cell $R_2$ pale because of the reduction of spotting to two spots, one over end of cell $R_2$ and one over r-m.

*Description*: From the type series, all mounted. Measurements from holotype ♀ and 9 ♀♀ paratypes.

*Female.*

*Head*: Eyes separate. Mouthparts at least equal to height of head. Basal flagellar segments uniform, about 1·5 times longer than wide, slightly vasiform; segment 11 about 1·75 × 10, segments 11–14 about equal, slightly vasiform, 15 pointed. Palp with segments 2 and 3 rather long and about equal, the third expanding slightly to its greatest width at three-quarters from base where a subterminal shallow sensory pit is situated.

*Thorax*: Legs uniform brown with pale knees and pale bases to mid and hind tibiae. Tibial comb 4. Tarsi unmodified, tarsal ratio 2·1. Wings as described under distinctive characters.

*Abdomen*: Two spherical spermathecae with short distinct ducts and a vestigial third.

*Distribution*: All known specimens from type locality including the Nattai River. Taken attracted to man in November and February to April.

### Culicoides henryi, n. sp.

*Types*: Holotype ♀, allotype ♂ and 10 paratype ♀♀. In SPHTM, except paratype in each of CSIRO, QIMR, USNM and BM.

*Type Locality*: Lota, south-east Queensland. Holotype, allotype and 7 paratypes, 11:ii:1955, E. J. Reye. The other paratypes with same data except 12:ii:1955 and 13:ii:1955.

*Distinctive Characters*: Closest to *C. victoriae* Macfie, but with wing spotting less pronounced. Pale spot over cell $R_2$ extending below base of intercalary fork; both branches of M dark. In *C. victoriae* the lower branch of the intercalary fork is dark towards the base and the basal pale spot in the median cell extends over both $M_1$ and $M_2$. In addition the pale spot in the intercalary area does not extend to the wing margin. The absence of apico-lateral processes on the ninth tergite is a major point of distinction of the male from that of *C. victoriae*. See also under *C. hornsbyensis*, n. sp.

*Description*: From the type series. Measurements from holotype, allotype and 9 ♀♀ paratypes. Unmounted material for description of thorax from Careel Bay, New South Wales.

*Female.*

*Head*: Eyes narrowly separated. Mouthparts about equal to height of head. Basal flagellar segments mostly vasiform, distal ones noticeably longer but still vasiform except 15. Segment 11 about twice length of 10. Antennal ratio 0·81.

*Thorax*: Brown, mesonotal pattern not of distinct spots but somewhat vague due to variation with light incidence. A large pale area centrally from level of humeral pits to distal part of prescutellar area surrounded by dark brown which includes scutellum. Additional irregular pale areas from humeral pits to margin of scutum but not including humeral corners and latero-median pale areas. Prescutellar sensory areas (Wirth and Blanton, 1959) black. Legs brown, distal tarsi paler. Femora paler preapically on anterior legs, not on hind pair; all tibiae pale subbasally; knees very dark. Tarsi unmodified, tarsal ratio 2·0. Tibial comb 4. Wings with macrotrichia moderately dense over distal half and lower part of anal cell. Radial cells well developed, second larger than first. Pattern as illustrated, differential points given above.

*Abdomen*: Two subequal subspherical spermathecae with very distinct necks and ducts.

*Male.*

Similar to ♀, except in characters of sex difference. Genitalia as illustrated.

*Distribution*: The type locality (in Moreton Bay) in Queensland. New South Wales: Careel Bay, light trap, 16:xi:1957, 27:xi:1957, 20:ii:1958, 19:iii:1958, 15:xi:1957, 18:xi:1957, 25:xi:1957, all D. J. Lee, and 20:x:1956, 30:x:1956, 3:xi:1956, 21:xii:1956, all light trap, W. W. Wirth; Berowra, 6:iii:1956, D. J. Lee; Cowan Cr., 29:x:1949, B. McMillan.

### Culicoides hornsbyensis, n. sp.

*Types*: Holotype ♀, allotype ♂ and 1 ♂ and 1 ♀ paratype. In SPHTM.

*Type Locality*: Hornsby, New South Wales, in light trap, D. J. Lee, 25:x:1956 for holotype and paratype ♂, 10:x:1956 for allotype and 24:x:1956 for paratype ♀.

*Distinctive Characters*: Wing with basic similarity to *C. henryi*, n. sp., but the third segment of the palp is similar only to *C. bancrofti* L. & R. which is a larger species with long vasiform basal antennal segments.

*Description*: From the types. Measurements include holotype, allotype and 1 ♀ paratype.

*Female.*

*Head*: Eyes separated. Mouthparts about equal to height of head. Antennae with basal segments barrel-shaped, 11–14 vasiform, segment 11 twice length of 10, antennal ratio 0·84. Palp with third segment enlarged, ovoid, its length slightly more than twice its width, extensively covered with small sensory pits.

*Thorax*: Brown with lighter brown areas, halteres pale. Legs uniformly light brown, no obvious markings. Tarsi unmodified, tarsal ratio 2·0. Tibial comb 4.

*Abdomen*: Two subequal, subspherical spermathecae with very short ducts and an accessory duct.

*Male.*

Similar to ♀ apart from sex differences, except wings with less strongly contrasting pattern and pale areas tending to be larger. Palp smaller but of similar form. Genitalia as illustrated.

*Distribution*: In addition to the type series this species has been taken in the same locality (Hornsby) on 29:i:1957, 7:ii:1957 and 8:ii:1957, all light trap, D. J. Lee.

### Culicoides fulbrighti, n. sp.

*Types*: Holotype ♀, allotype ♂, 16 ♀♀ paratypes and 6 ♂♂ paratypes. All in SPHTM, except paratypes in CSIRO, QIMR, USNM and BM.

*Type Locality*: Hornsby, New South Wales. All specimens from light trap, D. J. Lee, holotype and 1 paratype ♂ 4:x:1956, allotype and 1 ♂ paratype and 16 ♀♀ paratypes 6:x:1956, the remaining four ♂♂ paratypes 8:x:1956, 10:x:1956, 24:ix:1956 and 28:ix:1956.

*Distinctive Characters*: Although the distribution of pale spots is very similar to that of *C. victoriae*, all spots are larger and the dark areas greatly reduced. The r-m pale spot and the one over cell $R_2$ converge below the junction of the two radial cells. The male genitalia are intermediate between *C. victoriae* and *C. henryi*. In the latter the ninth tergite has no apico-lateral prolongations, in *C. fulbrighti* short prolongations are present and in *C. victoriae* they are long. See also *C. pallidothorax*, n. sp.

*Description*: From the type series. Measurements from holotype, allotype and 9 ♀♀ paratypes.

*Female.*

*Head*: Eyes narrowly separated. Mouthparts slightly less than height of head. Antennal flagellar segments vasiform, except apical one which tapers slightly. Segment 11 about 1·75 × 10. Antennal ratio 0·81. Palp with segment 3 slightly expanded at two-thirds from base; shallow sensory pit occupying distal third.

*Thorax*: Legs with broad pale areas at apices of femora and bases of tibiae; knees dark. Tarsi unmodified, tarsal ratio 2·2. Tibial comb 4. Wings with macrotrichia moderately well developed. Radial cells relatively large, both pale except for narrow dark area at junction of the two cells. Pale areas extensive, those on anterior half of wing almost coalescing.

*Abdomen*: Two subequal, ovate spermathecae with distinct ducts and two rudimentary ducts (one of these forms a third small spermatheca in one of the paratypes).

*Male.*

As for ♀ except for sex differences. Genitalia as figured.

*Distribution*: The type locality all months from September to February, always from light trap. Other localities from New South Wales are Careel Bay, November, February and April; Newport, December; Colo Vale, March.

### Culicoides pallidothorax, n. sp.

*Types*: Holotype ♀ and 4 paratype ♀♀. In SPHTM, except one paratype in each of CSIRO and USNM.

*Type Locality*: All of type series from Humpty Doo, Northern Territory, 29:xi:1956, A. K. O'Gower.

*Distinctive Characters*: Superficially very similar to *C. fulbrighti*, n. sp., on wing pattern but very distinct on coloration. *C. pallidothorax* is a pale yellowish species and considerably smaller than *C. fulbrighti*. Both of these species have much in common in wing pattern with *C. tritenuifasciatus* Tokunaga, but in both there are dark areas over the distal portions of $M_1$, $M_2$ and $Cu_1$, these being absent in *C. tritenuifasciatus*. However, the similarity of genitalia between *C. fulbrighti* and *C. tritenuifasciatus* does suggest a close affinity for these species.

*Description*: From the type series, measurements from holotype ♀ and 3 paratype ♀♀.

*Female.*

*Head*: Eyes separated above, almost touching below. Mouthparts equal to height of head. Basal flagellar segments barrel-shaped, becoming vasiform; 11–14 vasiform. Antennal ratio 0·93. Palpi pale, slender, segment 3 elongated but not conspicuously expanded, with small sensory pit about distal one-fifth.

*Thorax*: Brown around anterior and lateral margins to about half-way from anterior end. Just before scutellum, the scutellum itself and the postscutellum brown, the rest of the dorsal thorax yellowish. Lateral thorax with broad yellowish band across upper half, rest brown, legs pale with paler apices to femora and bases to tibiae; knees pale. Tarsi unmodified. Tarsal ratio 2·3. Tibial comb 4. Wings extensively pale, the distribution of pale areas very close to that of *C. fulbrighti*, n. sp.

*Abdomen*: Two subequal, subspherical spermathecae and a minute rudimentary one.

*Distribution*: Only known from the type locality.

(iii) *New Synonymy.*

### Culicoides brevitarsis Kieffer.

Kieffer, J. J., 1917. *Ann. Nat. Mus. Hung.*, 15: 187.

*New Synonymy*:

*Culicoides robertsi* Lee & Reye 1953.

Dr. P. Freeman of the British Museum was kind enough to arrange with Dr. Mikaly, of the National Museum of Hungary (Budapest), for the loan of certain Kieffer types for examination by himself and Dr. B. McMillan. The type of *C. brevitarsis* was compared with a paratype of *C. robertsi* and no important distinctions could be detected. Our original reluctance to recognize any Australian species as *C. brevitarsis*, due to the

description stating that the $M_{3+4} - Cu_1$ fork was immediately below the distal extremity of $R_{4+5}$ no longer held because this is not so in the holotype. All characters which could be determined with confidence in the Kieffer type as well as measurements indicate the need for the synonymy proposed above.

The above comparison was made in September, 1955. It is possible, following the disastrous fire in the Hungarian National Museum in October, 1956, that the type of *C. brevitarsis* is no longer in existence, in which case the type of *C. robertsi* would be available as a neotype.

### Culicoides victoriae Macfie.

Macfie, J. W. S., 1941. *Proc. R. Ent. Soc. Lond.* (B), 10: 67.

*New Synonymy*:

*Culicoides magnimaculatus* Lee & Reye 1953. Proc. Linn. Soc. N.S.W., 77 (1952): 388.

In our earlier papers on Australasian *Culicoides* Macfie's *C. victoriae* was inadvertently overlooked. Shortly after we became aware of its existence Dr. B. McMillan compared the type of *C. victoriae* with a paratype of our *C. magnimaculatus* and considered them to be identical.

However, in view of the absence of the distal antennal segments on the type of *C. victoriae* and because the large amount of material we have examined has shown evidence of geographic variation in wing pattern we hesitated to propose the synonymy given above. In the intervening time we have been unable to relate the wing pattern differences with any other characters, particularly of male genitalia, and our present view is that *C. victoriae* will eventually prove to be a species complex. Even though a number of segregates may emerge from this complex it now seems doubtful that *C. magnimaculatus* will be one of these.

A full biological investigation of this complex appears to be warranted as it is unlikely that any clarification will emerge from haphazard collecting.

*Acknowledgements.*

We wish to record our indebtedness to the co-operation of Dr. W. W. Wirth of the United States Department of Agriculture during his sojourn with us as a Fulbright Fellow in 1956–57 and to Mr. Ian Roper of the C.S.I.R.O. McMaster Animal Health Laboratory, University of Sydney, who prepared the wing photographs.

*References.*

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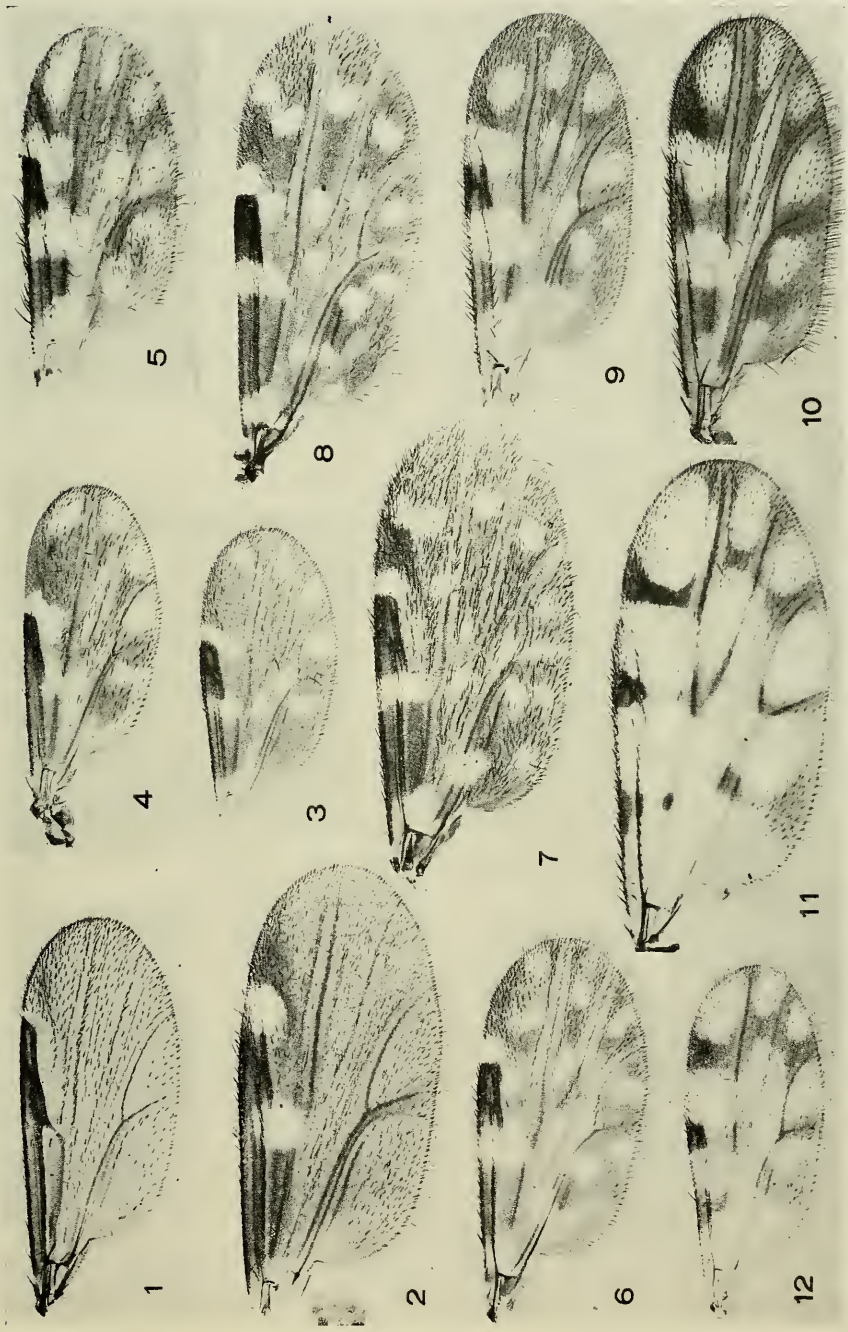
Lee, D. J., and Reye, E. J., 1955.—Australasian Ceratopogonidae (Diptera, Nematocera). Part VII. Proc. Linn. Soc. N.S.W., 79 (1954): 233.

Wirth, W. W., and Blanton, F. S., 1959.—Biting Midges of the Genus *Culicoides* from Panama (Diptera: Heleidae). *Proc. U.S. Nat. Mus.*, 109: 237.

### EXPLANATION OF PLATE XIII.

Figures 1-12. 1, *C. purus*, n. sp. 2, *C. mykytowyczi*, n. sp. 3, *C. marginalis*, n. sp. 4, *C. leanderensis*, n. sp. 5, *C. mackerrasi*, n. sp. 6, *C. narrabeenensis*, n. sp. 7, *C. interrogatus*, n. sp. 8, *C. sigmoidus*, n. sp. 9, *C. henryi*, n. sp. 10, *C. hornsbyensis*, n. sp. 11, *C. fulbrighti*, n. sp. 12, *C. pallidothorax*, n. sp. All x 66 approx.




Species of *Culicoides*.